

AUSTRALIAN RUST STUDIES. V.

ON THE OCCURRENCE OF A NEW PHYSIOLOGIC FORM OF WHEAT STEM RUST IN
NEW SOUTH WALES.

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It is now well recognized that the specialization exhibited by pathogens profoundly affects plant disease problems. A fundamental requirement in control of a disease is a knowledge of the physiologic forms of the organism which may occur. Any changes which take place in the forms that are present may affect the measures adopted.

Specialization in the rusts has long been known and is attracting world-wide attention. In Australia studies have been in progress for a number of years dealing with both the stem and leaf rusts of cereals. As far as wheat stem rust is concerned, the determinative methods of Stakman and Levine (1922) have been followed.

Seven naturally-occurring physiologic forms of *Puccinia graminis tritici* E. & H. have so far been recorded (Waterhouse, 1934). From 1921 until 1926, forms 43, 44, 45, 46, 54 and 55 were present. In 1926, form 34 was found in Western Australia. Next year it occurred in the Eastern States, and since then has almost completely superseded the other forms. The virulence of this form has been an important factor in the serious rust losses which have been experienced in recent years. Nevertheless the work of breeding wheats resistant to stem rust has been comparatively simple with the one form present.

In order to show the relative abundance and time distribution of the forms in Australia, the results of the specialization studies on wheat stem rust up to the 31st December, 1934, are summarized in Table 1.

TABLE 1.

Summary of the number of isolations of the naturally-occurring physiologic forms of *Puccinia graminis tritici* E. & H. in Australia.

Physiologic Form.	Season of isolation ending 31st March of year stated.														Totals.
	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935*	
11					4	18	152	156	90	181	139	143	93	2	2
34					15	14	21				10	1		161	1,137
43	20	10	10	55	3	30	6							2	158
44	2	4		1	3	30	6								46
45	3			15	5	17	5								45
46	14		15	24	1	6	2								62
54		1				3	1								5
55	2			5		1	2								10
Totals	41	15	25	100	28	89	189	156	90	181	149	144	93	165	1,465

* The record for 1935 extends only to 31st December, 1934.

The work of the current season has been largely helped, as usual, by officers of the State Departments of Agriculture and others who have forwarded rust specimens collected at various places from time to time. In all but four cases the rust present proved to be form 34. Two of the exceptions occurred in samples of rusted wheat from Casino and Kyogle, N.S.W., submitted by Mr. M. J. E. Squire. In these, form 43 was present mixed with form 34. It is interesting that all the records of form 43 since 1928 have been from this area in the N.E. corner of New South Wales and the S.E. corner of Queensland.

There were two other important exceptions. They were in wheats collected in November, 1934, the one by Mr. J. G. Churchward from Betric, N.S.W., the other by Mr. R. N. Medley from Leeton, N.S.W. These rusts proved to be form 34 mixed with another form. Cultural studies involving many cross-inoculations demonstrated that this rust was form 11. Its typical behaviour in comparison with that of the other naturally occurring Australian forms is set out in Table 2.

TABLE 2.

Typical reactions of the naturally-occurring physiologic forms of Puccinia graminis tritici in Australia.

Physiologic Form.	Type of reaction on differential wheat variety.											
	Little Club C.I. 4066.	Marquis C.I. 3641.	Kaured C.I. 5146	Kofa C.I. 5878.	Armutka C.I. 4072.	Mindun C.I. 5296.	Spehnars C.I. 6236.	Kulanka C.I. 2094.	Acme C.I. 5284.	Einkorn C.I. 2433.	Vernal Emmer C.I. 3686	Khapli C.I. 4013.
11	4	4	3+++	3+++	4	4	4	3+++	3+++	3	0;	1=
34	4	4	3+++	3+++	4	4	4	3+++	3+++	1=	0;	1=
43	4	3+++	0	0;	0;	0;	0;	x	1	3	1	0;
44	4	3+++	0	0;	0;	0;	0;	3+	3+	3	1	0;
45	4	2	0	2-	4	4	4	x	x	3	3	1
46	4	3+++	0	2-	4	4	4	1	1	3	3	1
54	4	3+++	0	0;	0;	0;	0;	1	3	3	1	0;
55	4	4	0	2-	4	4	4	x	x	3	3	1

The occurrence of this form is important. It is a virulent rust which has long been known in America. Controlled work at the University of Sydney extending over several years—as yet unpublished—has shown that form 34 is heterozygous. One of the forms frequently derived from barberries infected in the plant-house by cultures of form 34 is form 11. Cultural comparisons of the naturally-occurring form from wheat with those derived from the barberry reveal no differences between them.

Last year (Waterhouse, 1934*a*) naturally-infected barberries were recorded from the Central Tablelands of New South Wales where form 34 was present on graminaceous hosts. It has not been possible to trace the origin of the two collections of form 11 from Betric and Leeton back to barberry bushes, but it seems significant that so soon after finding infected barberries, this new form should be discovered. The eradication of susceptible types of barberry should be carried out without delay.

The presence of this virulent form 11 may influence the work of breeding wheats resistant to black stem rust. It is not yet possible to indicate the behaviour of parental types when inoculated with this form. This will be determined and the rust survey continued in order to obtain further evidence regarding its occurrence.

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Summary.

Specialization studies of *Puccinia graminis tritici* E. & H. have shown that between 1921 and 1934 seven forms have occurred naturally in Australia. Form 34 has been the most widespread. In November, 1934, wheat from two centres in New South Wales was found for the first time to be attacked by form 11. This is one of the forms which have been derived from the barberry in the plant-house when it is infected by the heterozygous form 34. Significance attaches to the discovery, in December, 1933, of naturally-infected barberries in New South Wales where form 34 was present on graminaceous hosts.

Literature Cited.

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Whilst this paper was in the press a further determination of importance has been made.

About the middle of March, 1935, a number of collections of rust on *Agropyron scabrum* Beauv. were made near Yetholme on the Central Tablelands. In all cases but one, the rust proved to be *P. graminis tritici* form 34. In the remaining instance form 11 was present in addition to form 34. This considerably strengthens the link with the infections of the barberries.